

# Updated Evidence on The Frequency, Severity, and Economic Consequences of Firefighter Musculoskeletal Disorders

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prepared for the Commission on Health and Safety and Workers' Compensation



Justice Policy Program

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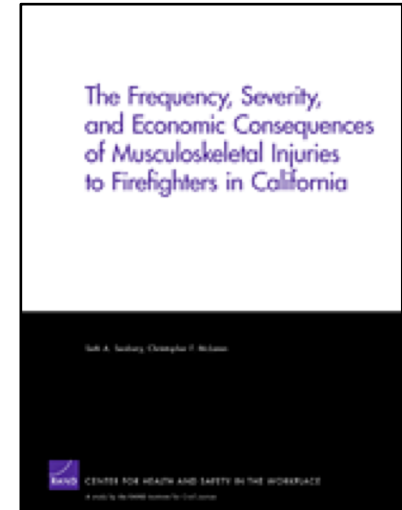
# Firefighter Musculoskeletal Disorders

- Firefighting important to study for many reasons
  - Dangerous work
  - High physical demands
  - Different injury compensation mechanisms
  - Critical to resilience in face of “new abnormal” wildfire threat



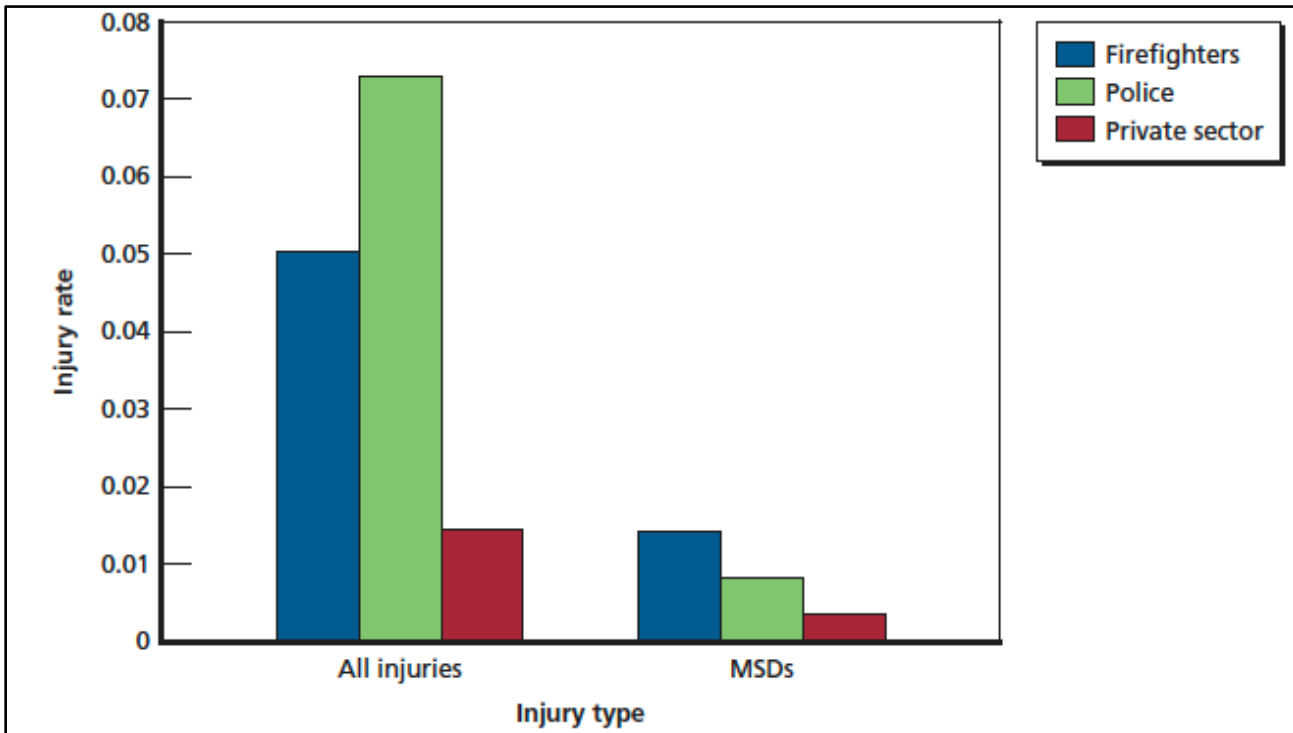
# RAND Studied Firefighter Musculoskeletal Disorders in 2010

- MSDs are the leading cause of nonfatal injury
- Past work showed
  - High rates of musculoskeletal disorders and injuries among firefighters
  - Less severe economic consequences
  - Worsening outcomes with age at injury



# Firefighters Have Very High Risk of MSDs

Figure 1: Comparison of musculoskeletal injury rates for public safety employees and other workers

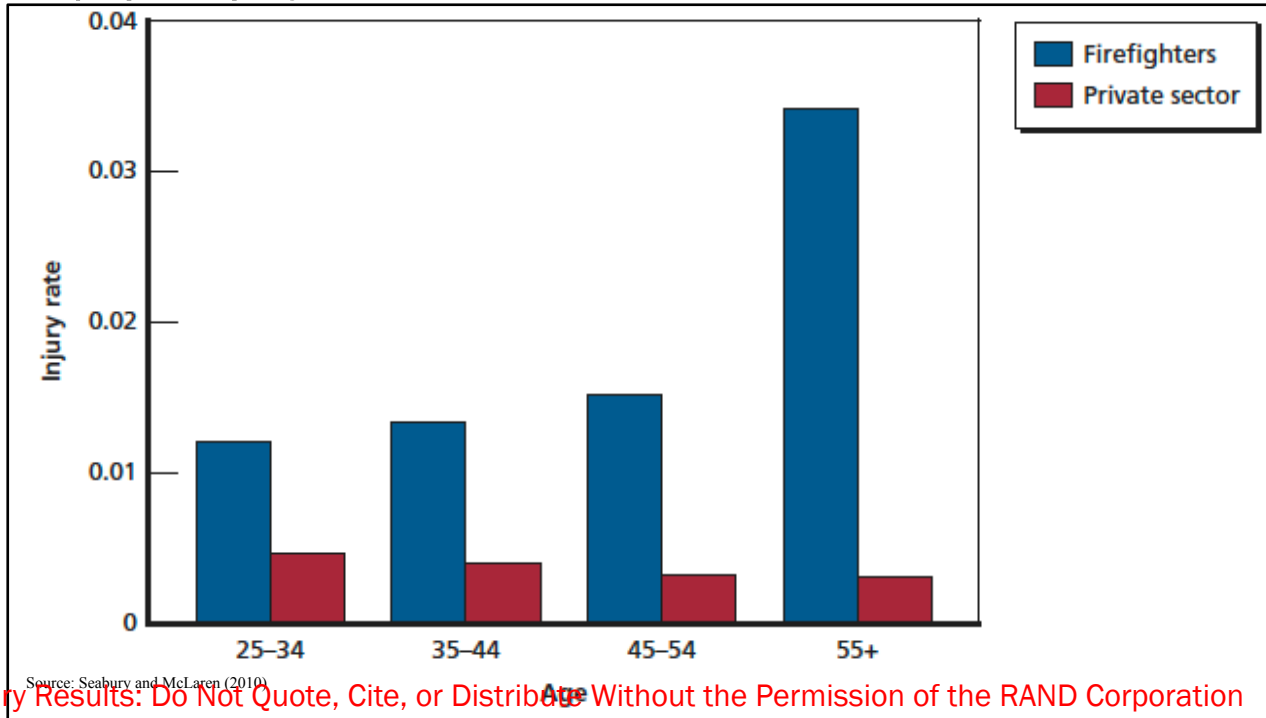


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Source: Seabury and McLaren (2010)

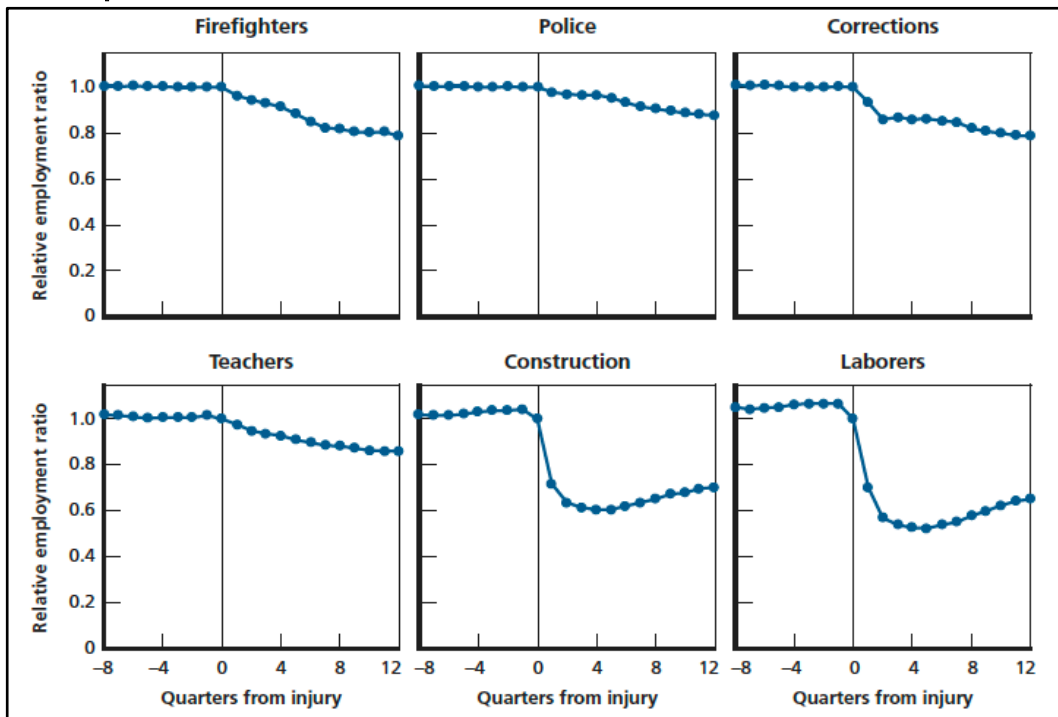
# MSD Risk Grows Dramatically as Firefighters Age

Figure 2: Musculoskeletal injury rates for firefighters and private sector employees by age



# Average Economic Outcomes for Firefighters Were Less Severe Than for Other Workers

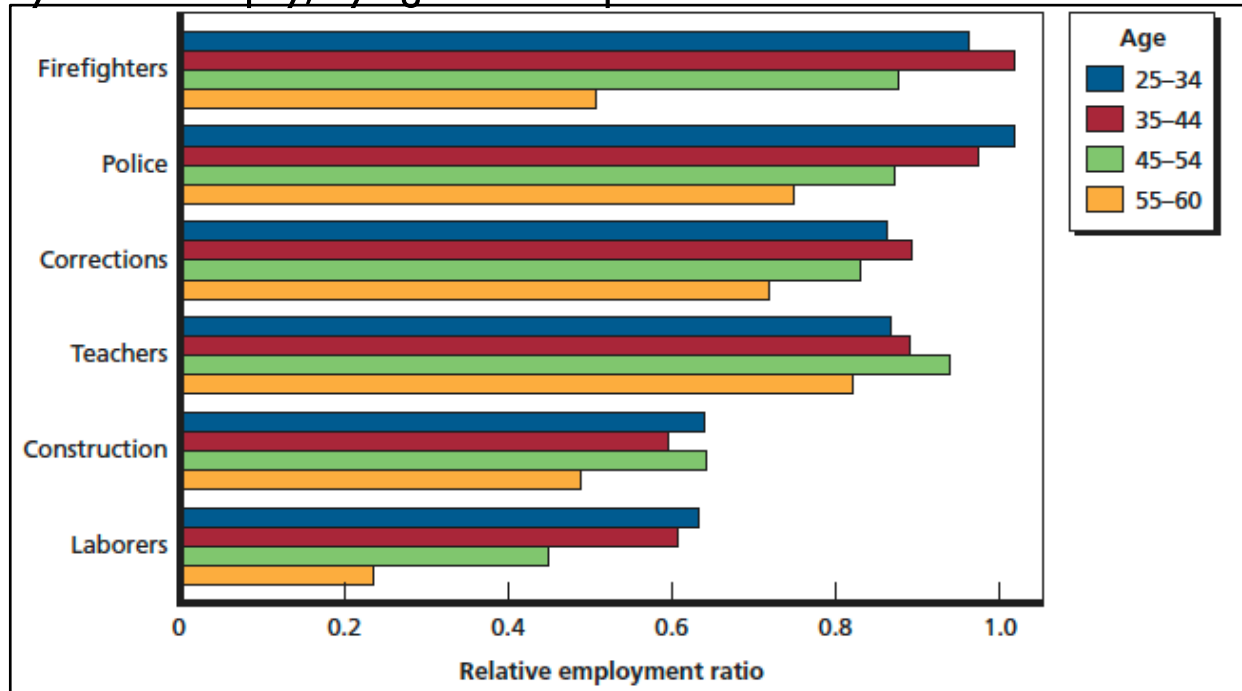
Figure 3: Relative employment before and after injury by occupation



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# But Economic Outcomes for Firefighters Deteriorated at Older Ages

Figure 4: Relative employment ratios for workers with back injuries two years after injury, by age and occupation



# We Reexamined Firefighter MSDs in Light of Changes in the Labor Market, WC Policy

- A changing economy
  - Great Recession
  - Aging workforce
- Workers' compensation reforms (SB 863)
- Greater awareness of PTSD and other psychiatric sequelae of acute injuries



# Overview of Research Questions

- Frequency and case-mix
- Economic consequences
- Disability ratings
- Treatment caps
- Psychiatric comorbidities

# We Use Data on WC Claims, Disability Ratings, Earnings, and Medical Treatment

- Extract data on injured workers from databases maintained by DWC and EDD
- Frequency, composition of MSD injuries
  - Study 2005-2018 injuries
- Earnings, benefits, PTSD, medical treatment
  - Study 2005-2015 injuries to capture follow-up

# Use WCIS First Report of Injury to Identify Musculoskeletal Disorder Claims

- No consensus definition of MSD in literature
- We define MSD based on nature of injury and body part of injury
- Nature of Injury must be
  - Strain, Sprain, Cumulative Injury NOC, Carpal Tunnel Syndrome, Inflammation, Hernia, Dislocation, or Rupture
- **and** Body Part of Injury must be
  - Extremities, Neck, or Trunk (excl. fingers/toes/internal organs)
- Sensitivity analysis: use diagnosis codes on medical claims

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# Study Focuses on Active Firefighters

- Match WC claim occupation field against job titles reported by active firefighters to DOL O\*Net survey
  - Fuzzy match to allow spelling errors
- Add occupations reported in class code 7706 (Firefighting Operations–not volunteers)
- Refine further using class codes
- Included occupations reviewed by a fire chief

# We Select Occupation Titles Indicating Active Firefighting

- E.g: Firefighter; Fire Engineer; Fire Equipment Operator; Fire Lieutenant; Battalion Chief
- Include firefighters and first-line supervisors
- Include municipal and wildland firefighters
- Exclude: Volunteers; Inmates; Dispatchers; Mechanics; Arson Investigators; Fire Inspectors

# Firefighter Job Demands, Labor Relations Differ Sharply from Most Other Jobs

- High physical, mental job demands
- Public-sector employees
  - Low turnover/rigorous hiring practices
  - Heavily unionized
  - Retirement/disability pension coverage
- Public safety worker benefits (LC §4850)

# We Compare Firefighters to Police and Other Public-Sector Occupations

|                         | Active Firefighters | Active Police | Other Public-Sector Workers | Private-Sector Comparison Group |
|-------------------------|---------------------|---------------|-----------------------------|---------------------------------|
| High Job Demands        | Y                   | Y             |                             | Y                               |
| Public-Sector Employees | Y                   | Y             | Y                           |                                 |
| Public Safety Workers   | Y                   | Y             |                             |                                 |

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# Active Police Defined Using Similar Approach

- Use O\*Net job titles, occupations reported in class 7720 (Police/Sheriffs–not volunteers)
- Refine further using class codes
- E.g: Police Officer; Security Officer; Police Sergeant; Deputy Sheriff; Police Detective
- Exclude: Correction Officers; Animal Control; Fish & Wildlife Officers



# Other Public-Sector Workers Identified Using Class Codes

- Use class codes specifically indicating municipal, state, public agency employment
  - E.g., 9410, 9420, 8875, 8868, 7580, etc.
- E.g: Teacher; Correctional Officer; Custodian; Registered Nurse; Teacher Aide; Public Agency Employee; Bus Driver; Maintenance Worker
- Exclude workers classified as active fire/police

# Compare to Private-Sector Workers with Job Demands Most Similar to Firefighting

- DOL O\*Net survey measures job demands
- Workers across all US occupations asked to rate their job on how often different job demands or activities occur
- Compare responses to 55 questions for all occupations
- Choose 25 occupations with closest match to firefighting
- Ranking on physical demands only yields similar results

# Selected Job Demands on which Firefighting Differs from Average US Occupation

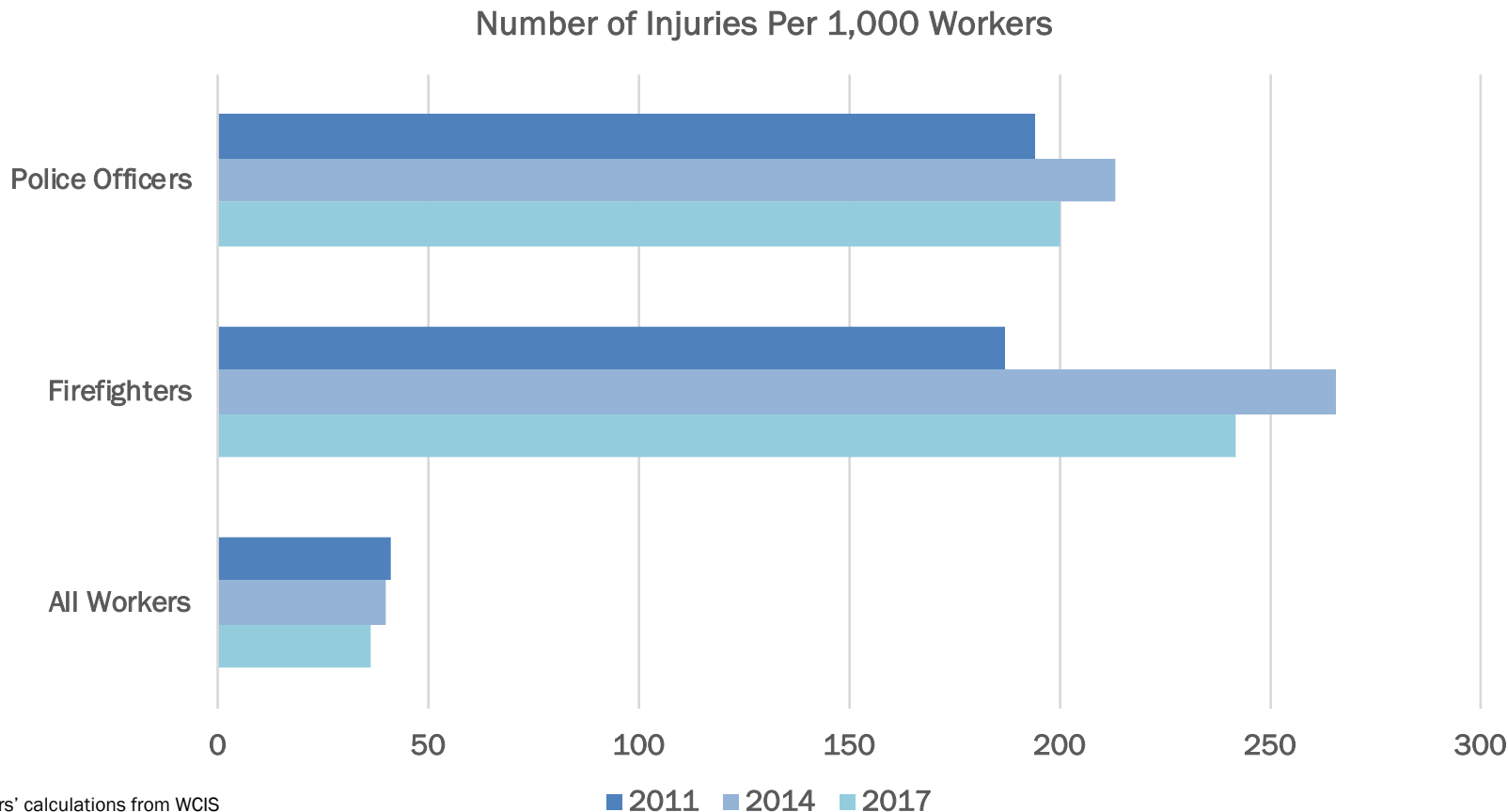
- Interpersonal relationships
  - Deal with physically aggressive people
  - Responsible for others' health and safety
- Physical work conditions Outdoors, Exposed to Weather
  - Exposed to disease or infections
  - Wear specialized protective or safety equipment
  - Outdoors, exposed to weather
- Structural job characteristics
  - How serious [are consequences of] a mistake that was not ... correctable?
  - How do decisions ... impact results of co-workers, clients or the company?
  - Level of competition

# Private-Sector Comparison Group Uses Top 25 Occupation Matches Excluding Fire and Police

- |   |   |  |
|---|---|--|
| 1. Municipal Fire Fighting and Prevention Supervisors                 | 10. Electrical and Electronics Repairers, Powerhouse, Substation, and Relay | 19. Mates- Ship, Boat, and Barge   |
| 2. Fire Investigators   | 11. Pilots, Ship  | 20. Ambulance Drivers and Attendants, Except Emergency Medical Technicians |
| 3. Forest Firefighters  | 12. Sheriffs and Deputy Sheriffs  | 21. Refrigeration Mechanics and Installers                                 |
| 4. Emergency Medical Technicians and Paramedics                       | 13. Weatherization Installers and Technicians                               | 22. Septic Tank Servicers and Sewer Pipe Cleaners                          |
| 5. Forest Fire Fighting and Prevention Supervisors                    | 14. Police Identification and Records Officers                              | 23. Millwrights  |
| 6. Control and Valve Installers and Repairers, Except Mechanical Door | 15. Commercial Divers   | 24. Commercial Pilots  |
| 7. Telecommunications Line Installers and Repairers                   | 16. First-Line Supervisors of Police and Detectives                         | 25. Occupational Health and Safety Technicians                             |
| 8. Transit and Railroad Police  | 17. Industrial Safety and Health Engineers                                  |  |
| 9. Hydroelectric Plant Technicians                                    | 18. Elevator Installers and Repairers                                       |  |

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# Firefighters have higher frequency of injuries

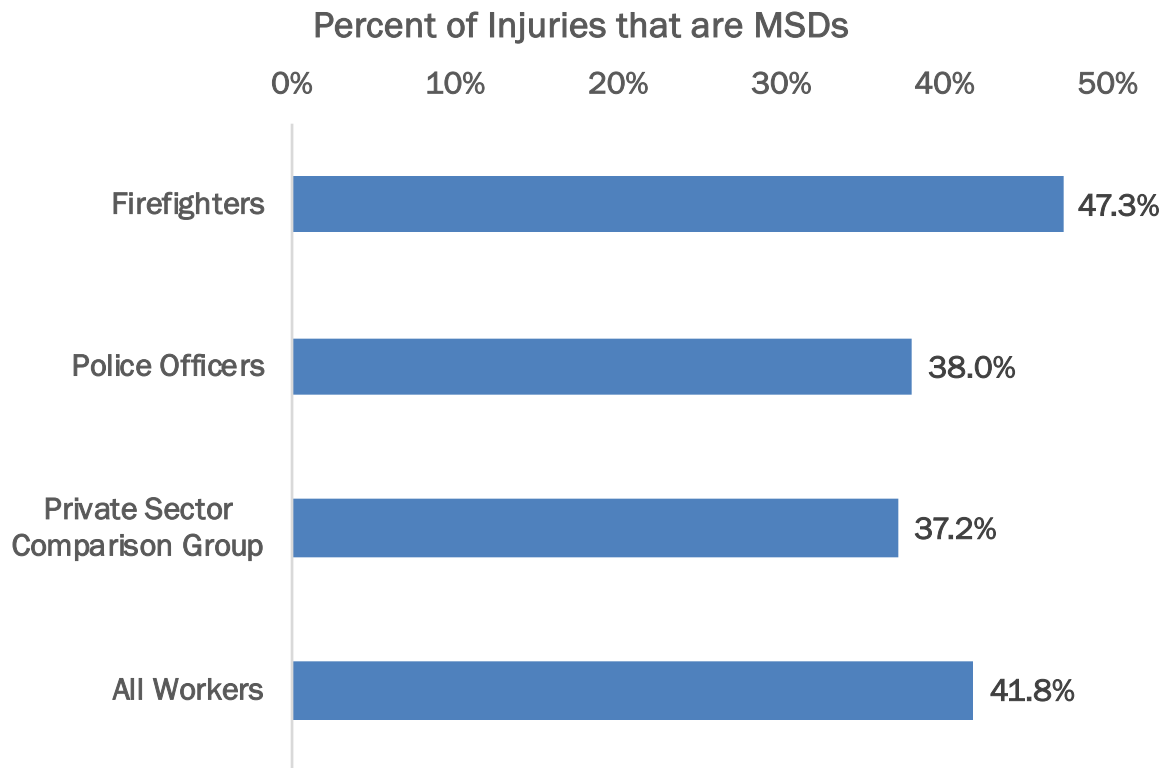


Source: Authors' calculations from WCIS

Employment figures from BLS Regional Employment  
Statistics

Preliminary Results: Do Not Quote, Cite, or Distribute Without the Permission of the RAND Corporation

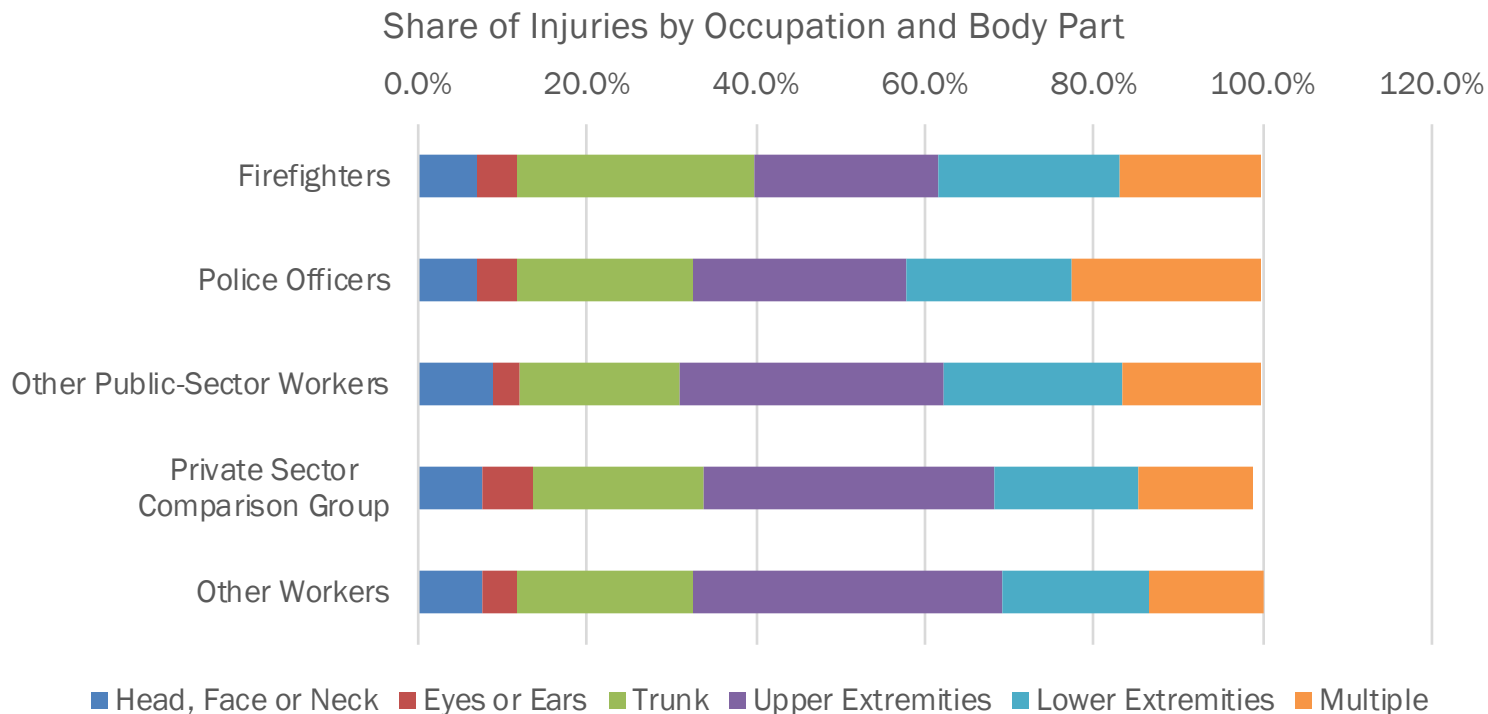
# Nearly Half of Firefighter Injuries are MSDs



Source: Authors' calculations from WCIS

Preliminary Results: Do Not Quote, Cite, or Distribute Without the Permission of the RAND Corporation

# Firefighters Have a Higher Share of Injuries to the Trunk and Lower Extremities

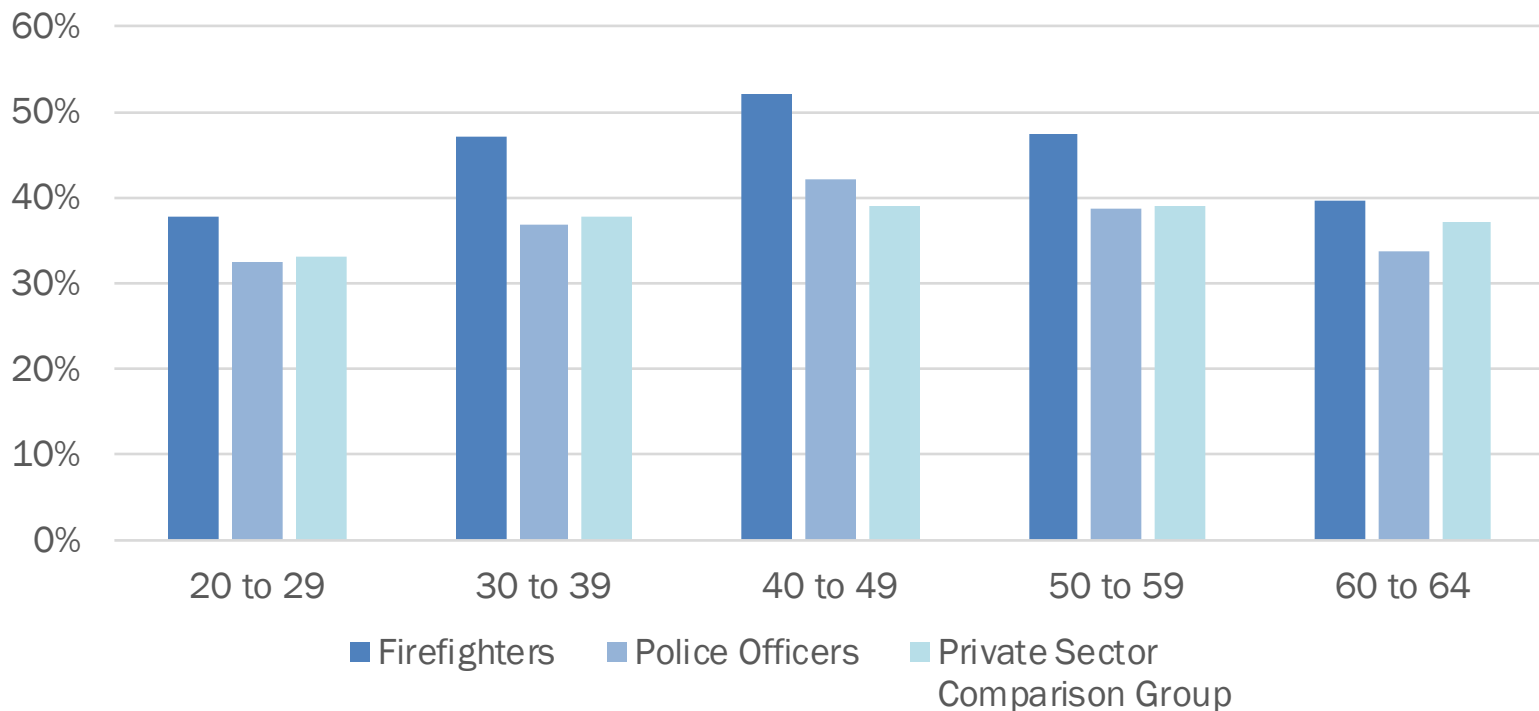


Source: Authors' calculations from WCIS

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# MSDs are High for Firefighters in All Age Groups

Percent of Injuries that are MSDs by Occupation and Age



Source: Authors' calculations from WCIS

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# Earnings Loss Methods

- Estimate earnings, employment outcomes
- Compare to injuries in other occupations
- Examine effect of age
- Test for differences in age profile across occupations

# Earnings Loss Estimation Methods

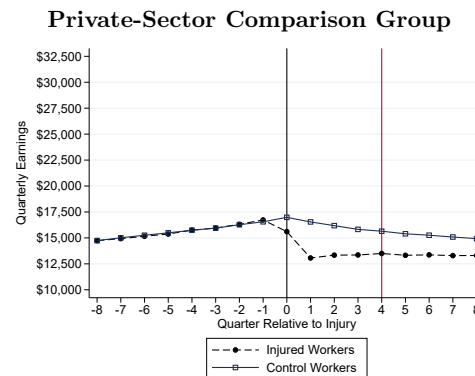
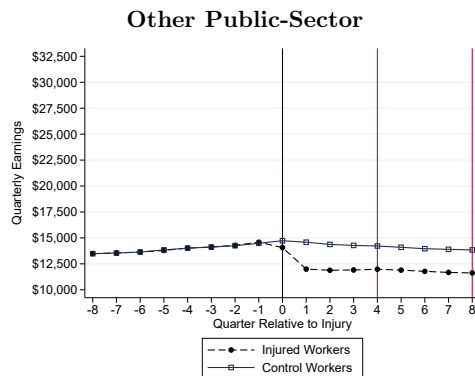
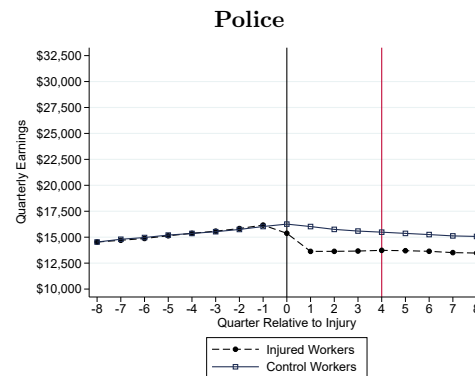
- Wage loss is difference between
  - what worker actually earns after injury
  - what worker would have earned without injury
- Need control group to isolate impact of injury from other earnings dynamics
  - Layoff, retirement, non-work disability, etc.

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# Earnings Loss Estimation Methods

- Main estimates follow past RAND studies and use uninjured co-workers as control group
- Workers at same employer with same earnings and job tenure, but no injury claim
- Use medical-only cases to study age differences
- Additional analysis to address impact of §4850

# Difference between Injured Control Earnings After Injury Provides Estimate of Loss



Source: authors' calculations, 2005-2015 indemnity injuries in WCIS-EDD data

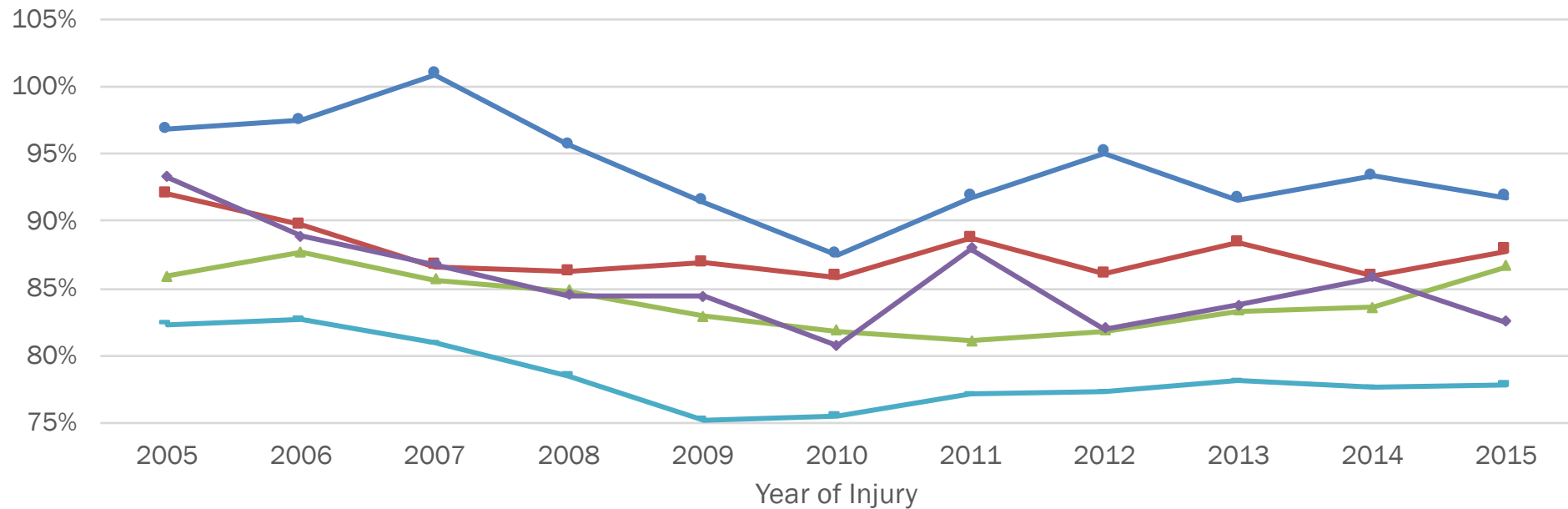
# Earnings and Employment by Occupation for 2005-2015 MSD Indemnity Claims

|                                  | Active Firefighters | Active Police | Other<br>Public-Sector | Private-Sector<br>Comparison |
|----------------------------------|---------------------|---------------|------------------------|------------------------------|
| Earnings (\$)                    |                     |               |                        |                              |
| 1 Year Pre-Injury                | \$118,927           | \$60,655      | \$56,861               | \$64,429                     |
| 1 Year Post-Injury               | \$108,970           | \$51,600      | \$47,333               | \$51,672                     |
| 2 Years Post-Injury              | \$110,937           | \$51,614      | \$47,098               | \$52,062                     |
| Relative Earnings                |                     |               |                        |                              |
| 1 Year Post-Injury               | 92%                 | 85%           | 83%                    | 81%                          |
| 2 Years Post-Injury              | 95%                 | 88%           | 85%                    | 87%                          |
| Relative At-Injury<br>Employment |                     |               |                        |                              |
| 1 Year Post-Injury               | 97%                 | 86%           | 90%                    | 80%                          |
| 2 Years Post-Injury              | 95%                 | 82%           | 87%                    | 75%                          |
| Sample Size                      | 7,995               | 21,637        | 84,652                 | 5,251                        |

Source: authors' calculations, 2005-2015 MSD indemnity injuries in WCIS-EDD data

# Firefighter Outcomes Declined Sharply During Great Recession and Recovered Only Partially

Relative Earnings Over Two Years After Indemnity MSD Injury,  
by Occupation



Active Firefighters Active Police Other Public-Sector Private-Sector Comparison Rest of WCIS

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# Earnings Declined for Firefighters, But Remained Above Other Occupations

|                           | Active Firefighters | Active Police | Other Public-Sector | Private-Sector Comparison |
|---------------------------|---------------------|---------------|---------------------|---------------------------|
| All Years<br>(2005-2015)  | 94.7%               | 87.7%         | 84.0%               | 85.9%                     |
|                           |                     |               |                     |                           |
| Pre-SB863<br>(2005-2012)  | 95.5%               | 87.9%         | 83.8%               | 86.6%                     |
| Post-SB863<br>(2013-2015) | 92.2%               | 87.4%         | 84.6%               | 83.9%                     |

Source: ~~Preliminary Results. Do Not Quote, Cite or Distribute Without the Permission of the RAND Corporation.~~ authors' calculations, 2005-2015 indemnity injuries in WCIS-EDD data

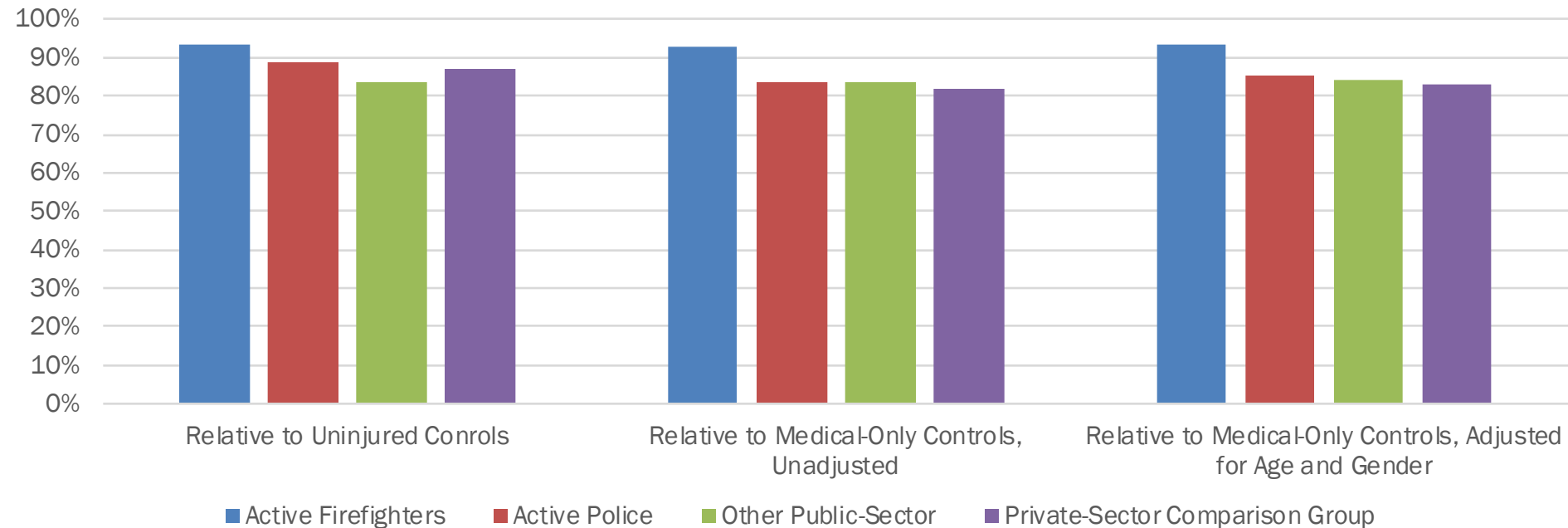
# Do Demographic Differences for Firefighters Drive Results?

- Compare indemnity injuries to medical-only injuries instead of uninjured controls
- Adjust for age, gender, cause of injury
- Compare average earnings losses by occupation
- Compare earnings loss by age group



# Earnings Loss Differences Across Occupations Not Driven by Demographics

Relative Earnings Over Two Years After Indemnity MSD Injury  
by Occupation, With vs. Without Adjustment for Demographics

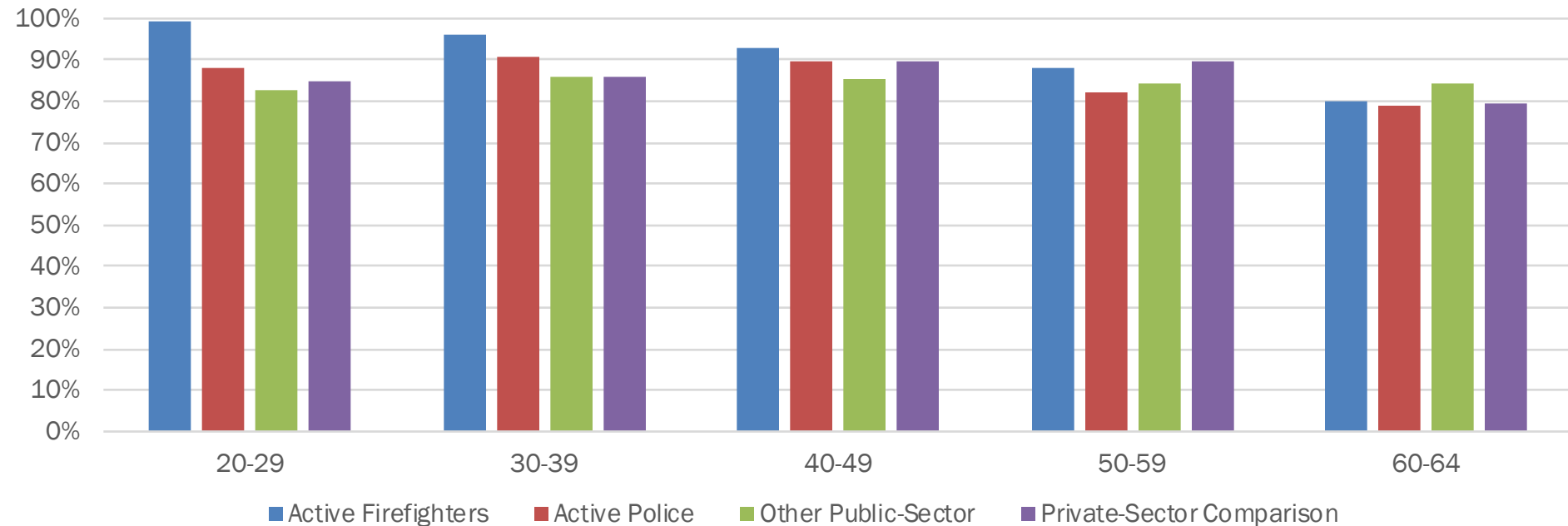


Source: authors' calculations, 2005-2015 injuries in WCIS-EDD data

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# Firefighter Earnings Losses Less Severe Than Comparison Groups Until Age 60

Adjusted Relative Earnings Over Two Years After Indemnity MSD Injury  
by Age and Occupation

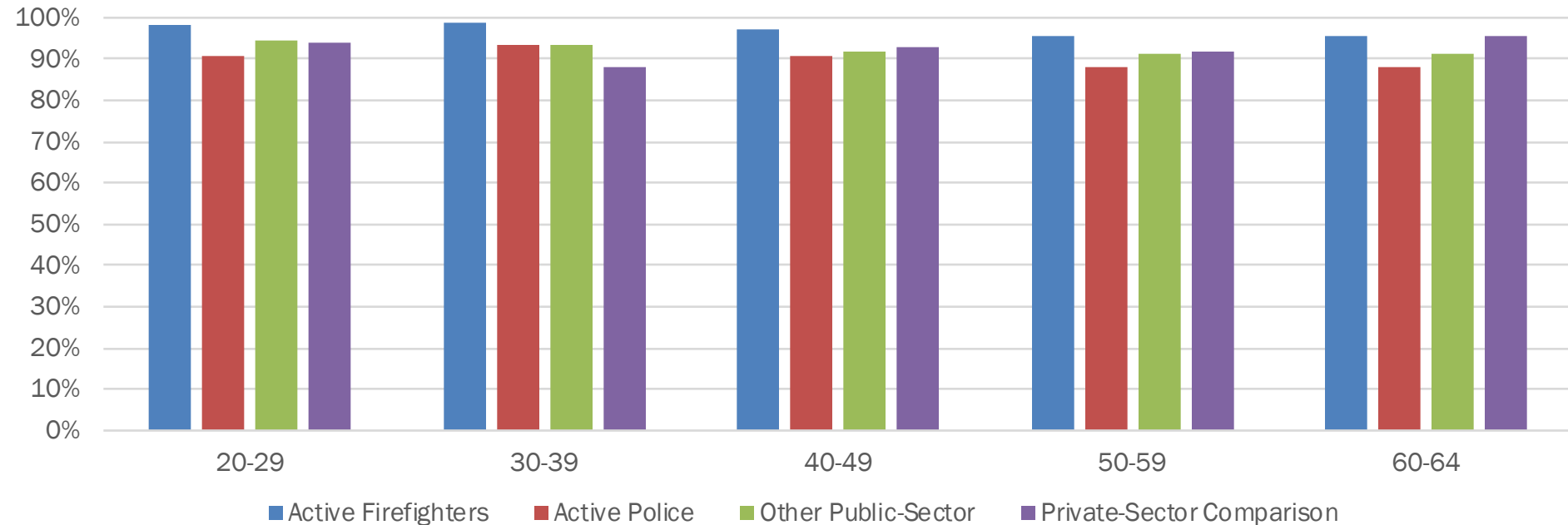


Source: authors' calculations, 2005-2015 injuries in WCIS-EDD data

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# Higher Return to Work Likely Contributes to Better Outcomes for Firefighters

Adjusted Return to Work at Same Employer Two Years After Indemnity  
MSD Injury, by Age and Occupation



Source: authors' calculations, 2005-2015 injuries in WCIS-EDD data

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# Accounting for §4850 Time

- LC §4850 provides public safety workers additional benefits after workplace injury
  - 1 year of leave at full salary, tax-exempt
  - In lieu of temporary disability payments
  - TTD benefits begin after 1 year
- Reported to WCIS as Employer Paid
- We count §4850 cases as indemnity injuries

# §4850 Reporting Practices May Not Be Uniform Across All Jurisdictions

- Some may report to EDD as earnings
- Some may not report to WCIS
- To assess robustness, repeated analysis
  - For second-year earnings (after 4850 time limit)
  - Using lower-severity medical-only cases as controls
- Findings very similar to those reported above

# Disability Ratings and Medicolegal Issues: Occupational Patterns and Impacts of SB 863

- Analyze ratings performed by DWC
- Final ratings
- Body part of injury
- Psychiatric impairments
- Apportionment

# SB 863 Raised PD Benefits and Modified Ratings, but Restricted Add-on Impairments

- Maximum weekly PD benefit raised from \$230 to \$290 per week; first increase since 2006
- FEC multiplier set to maximum (1.4) for all impairments; impact depends on body part
- Secondary (add-on) impairments eliminated
  - Psychiatric; Sleep disorders; Sexual dysfunction

# We Use 2005-2015 Injuries Rated at DWC's Disability Evaluation Unit (DEU)

Sample Size by Injury Date for DEU Rating Analysis  
Ratings Performed within 33 Months After Injury

| Injury Date | Firefighters | Police | Other Public Sector | Private Sector | Total  |
|-------------|--------------|--------|---------------------|----------------|--------|
| 2005-2012   | 2,405        | 5,326  | 18,986              | 1,128          | 27,845 |
| 2013-2015   | 652          | 1,375  | 4,056               | 235            | 6,318  |
|             |              |        |                     |                |        |
| 2005-2015   | 3,057        | 6,701  | 23,042              | 1,363          | 34,163 |

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Source: Authors' calculations, DEU ratings with linked WCIS data, 2005-2015 injuries rated <= 1005 days after injury

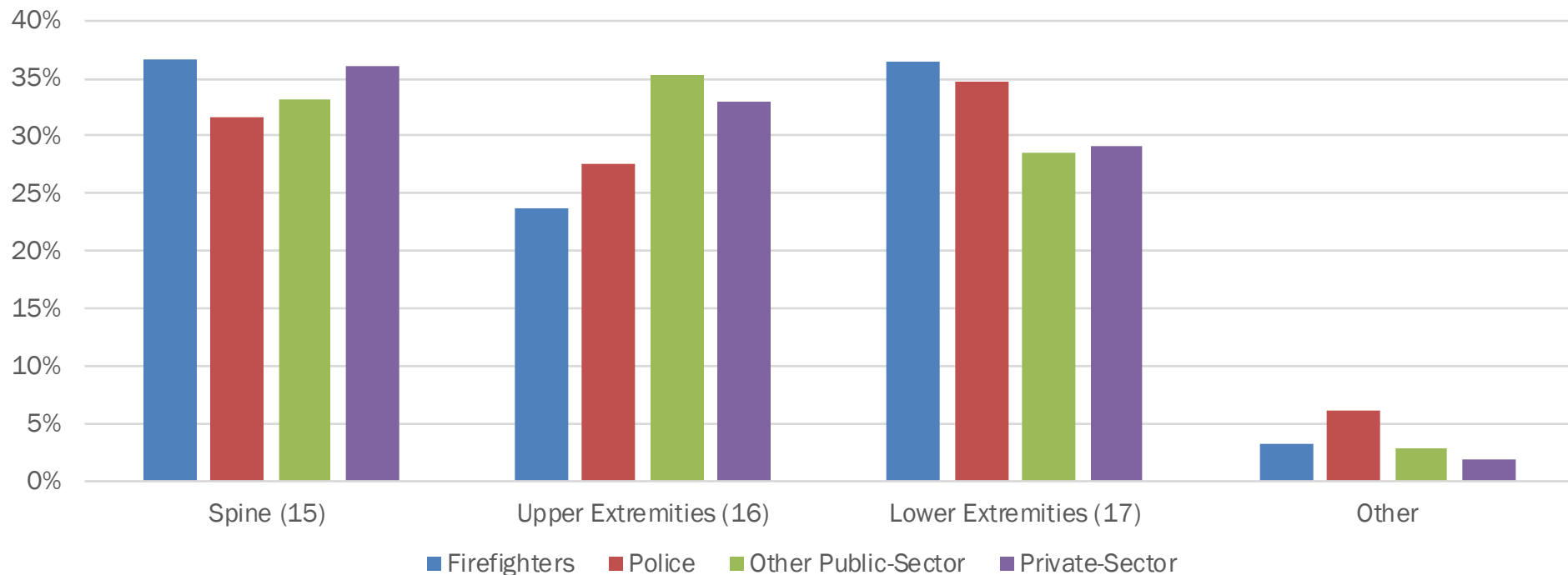


# Firefighters Have Far Fewer Consult Ratings at DEU, Requiring Adjustment for Rating Type

|                          | Firefighters | Police | Other Public-Sector | Private Sector |
|--------------------------|--------------|--------|---------------------|----------------|
| Consult Average          | 24.3         | 22.1   | 20.5                | 23.5           |
| Summary Average          | 12.6         | 11.3   | 11.0                | 12.3           |
| % Consult Ratings        | 24%          | 41%    | 35%                 | 44%            |
|                          |              |        |                     |                |
| Unweighted Average       | 15.4         | 15.8   | 14.4                | 17.3           |
| Adjusted for Rating Type | 15.4         | 13.9   | 13.3                | 14.9           |

# Firefighters More Likely to Have Spine or Lower Extremities as Highest-Rated Body Part

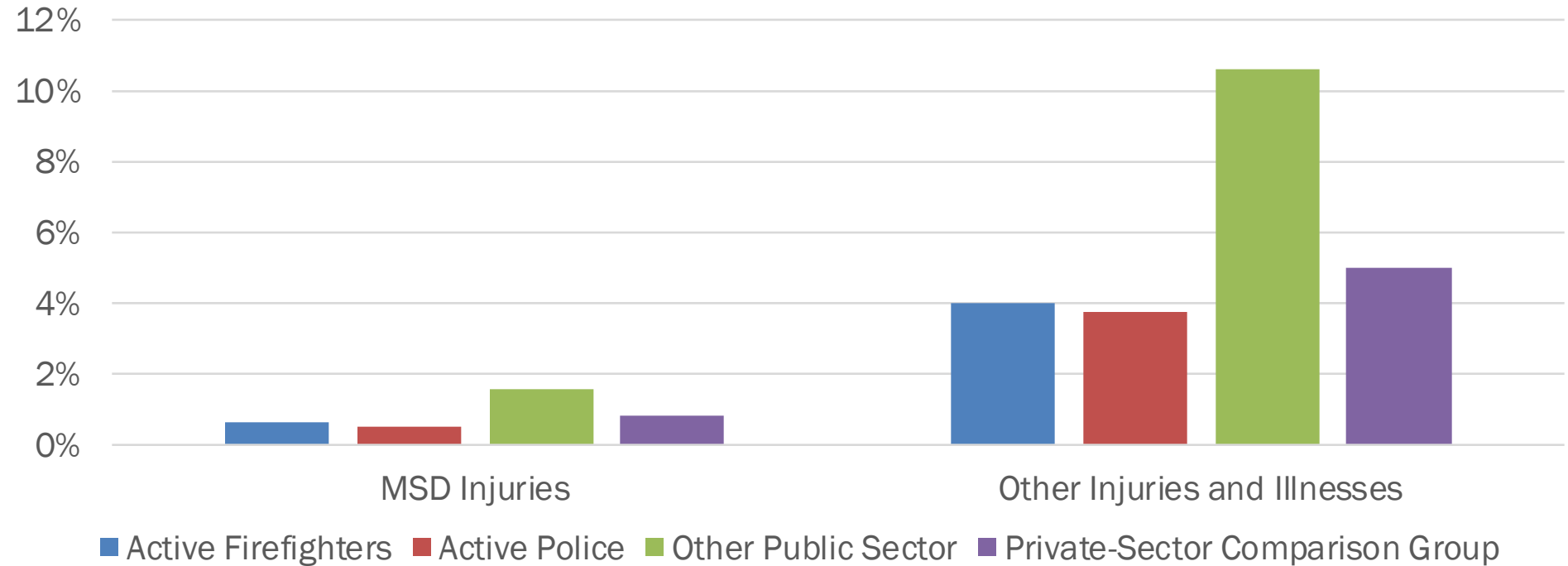
Body System of Highest-Rated Impairment in MSD Injuries



Source: Authors' calculations, DEU ratings with linked WCIS data, 2005-2015 injuries rated  $\leq 1005$  days after injury  
Preliminary Results: Do Not Quote, Cite, or Distribute Without the Permission of the RAND Corporation

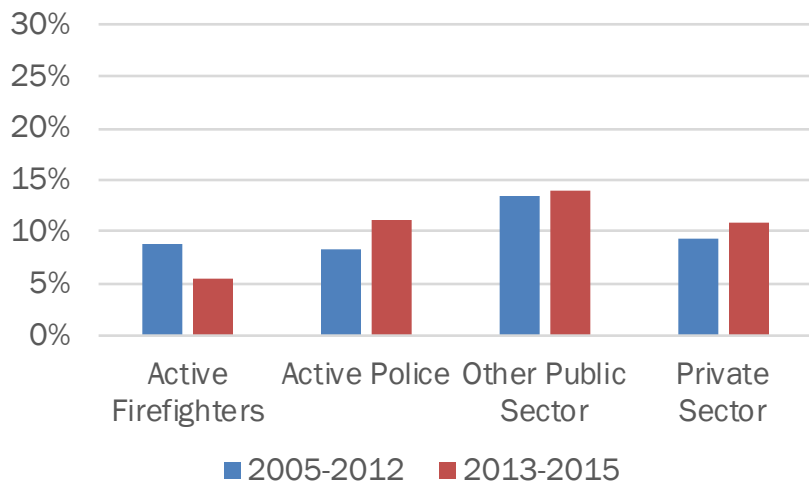
# Psychiatric Impairments Infrequently Rated with Primary MSD Injuries in All Occupations

Share of DEU-Rated Cases with Any Rated Psychiatric Impairments

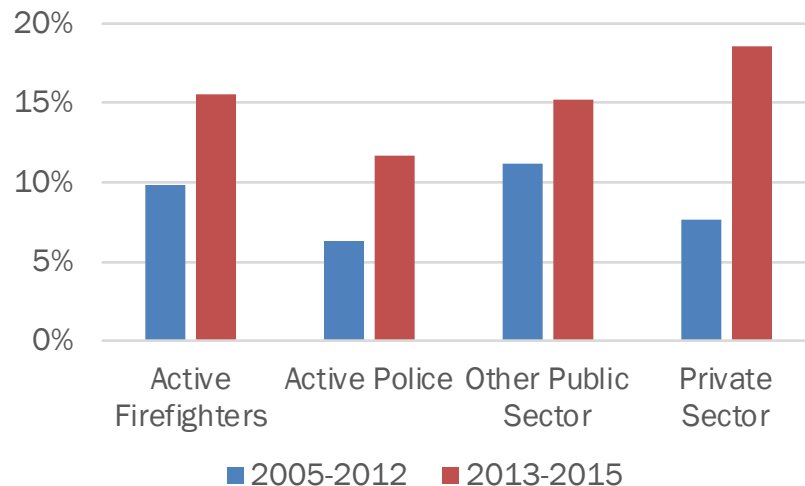


# Apportionment Has Increased on Consult Ratings, But Not Summary Ratings

Share of Cases with Any Apportionment Applied, MSD Summary Ratings



Share of Cases with Any Apportionment Applied, MSD Consult Ratings

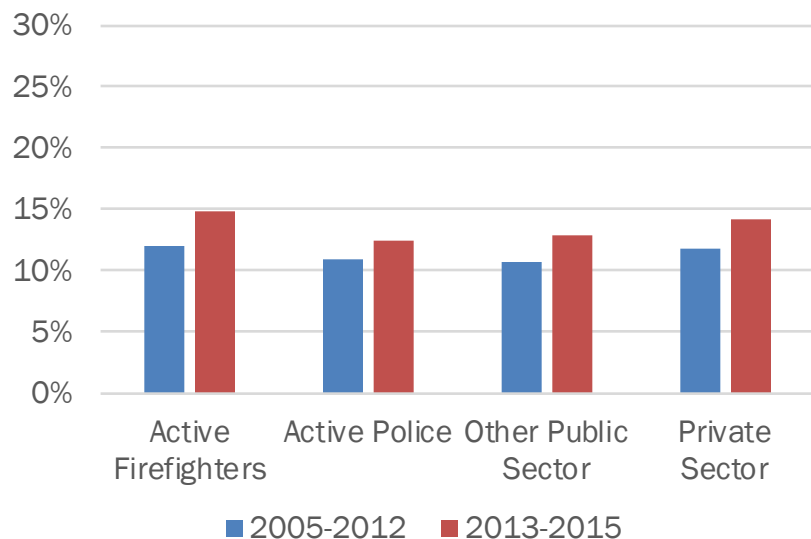


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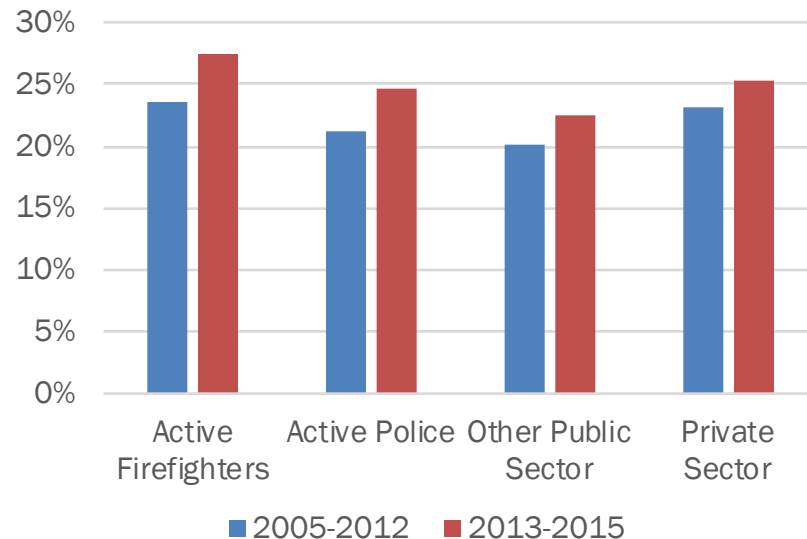
Source: Authors' calculations, DEU ratings with linked WCIS data, 2005-2015 injuries rated  $\leq 1005$  days after injury 44

# Firefighters, Other Occupations, Received Higher Ratings After SB 863

Average Final Rating by Injury  
Date, MSD Summary Ratings



Average Final Rating by Injury  
Date, MSD Consult Ratings

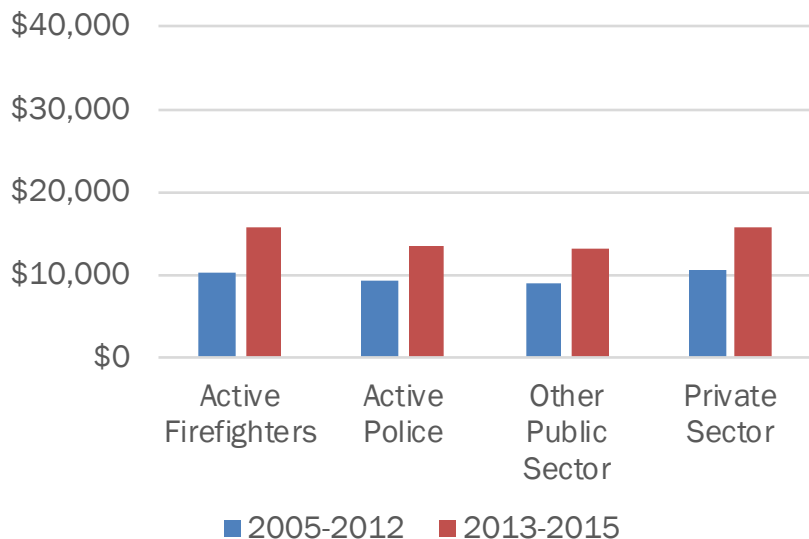


Source: Authors' calculations, DEU ratings with linked WCIS data, 2005-2015 injuries rated  $\leq 1005$  days after injury.  
Table reports final ratings after apportionment.

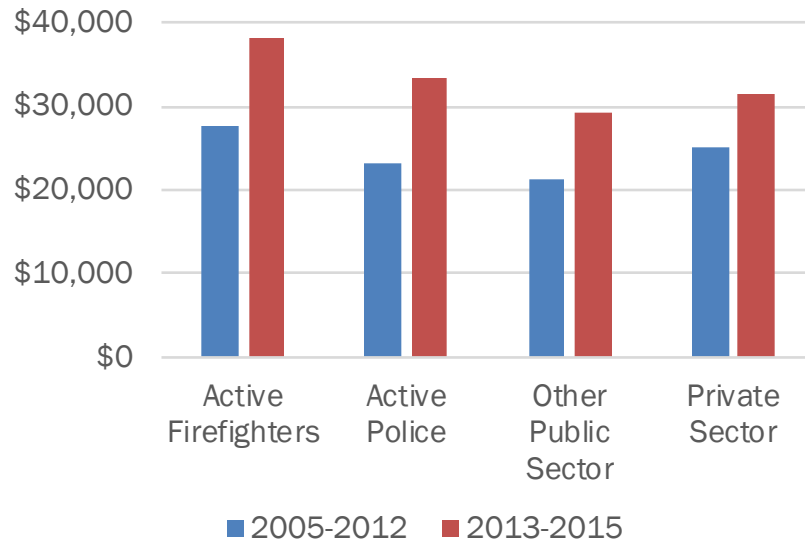
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# Statutory Benefits Increased After SB 863

Statutory Benefits by Injury Date, MSD Summary Ratings



Statutory Benefits by Injury Date, MSD Consult Ratings



Source: Authors' calculations, DEU ratings with linked WCIS data, 2005-2015 injuries rated  $\leq 1005$  days after injury.  
Benefits calculated at statutory maximum wage using final rating after apportionment.

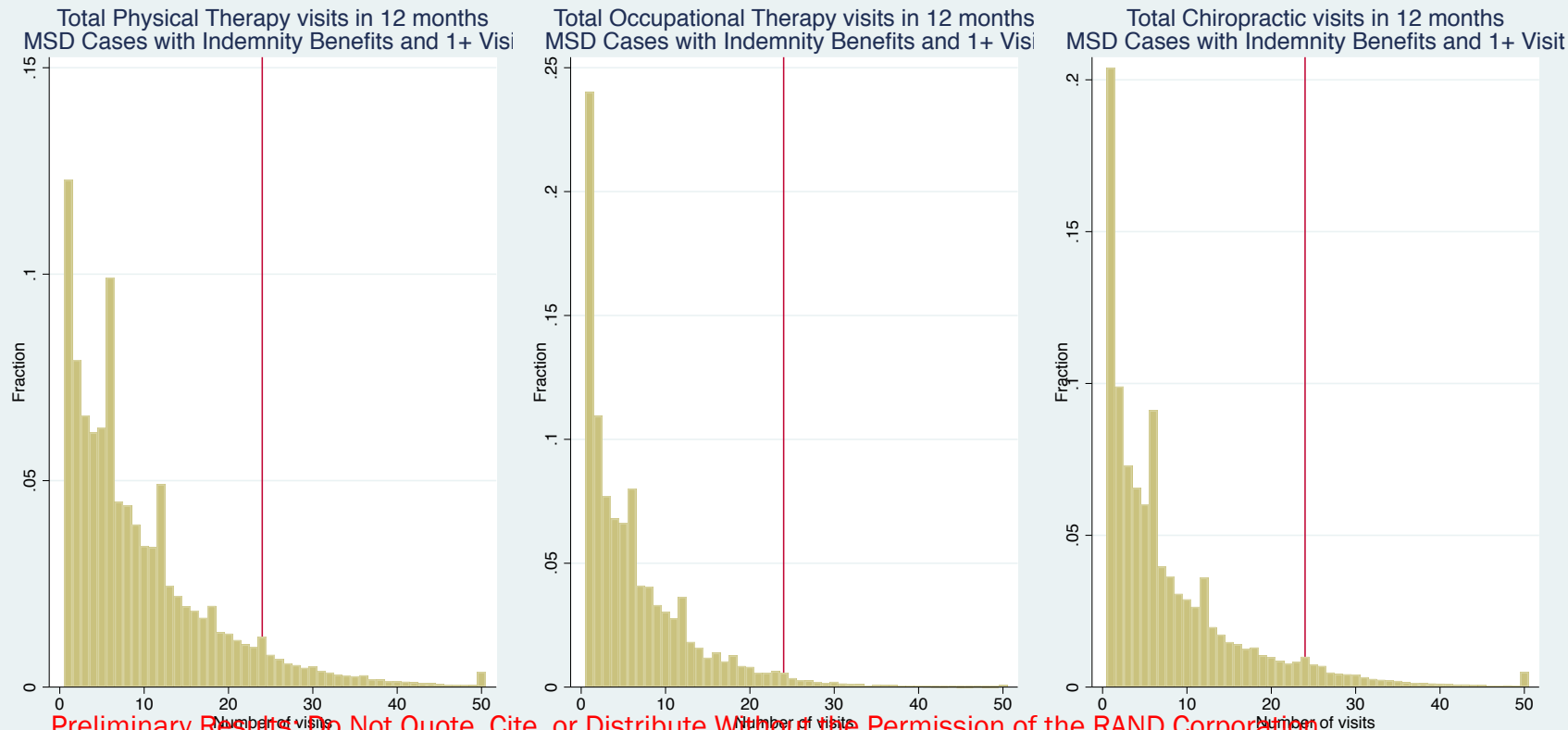
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# Are the SB 228 Visit Caps Affecting Treatment Patterns for MSD Cases?

- LC §4604.5(d) imposes a cap of 24 visits for
  - Chiropractic
  - Physical Therapy
  - Occupational Therapy
- Authorization by employer required to exceed cap
- Early evidence showed sharp reductions in spending, average visits on capped services

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# Visit Counts Suggest that Cap Affects Relatively Few Workers



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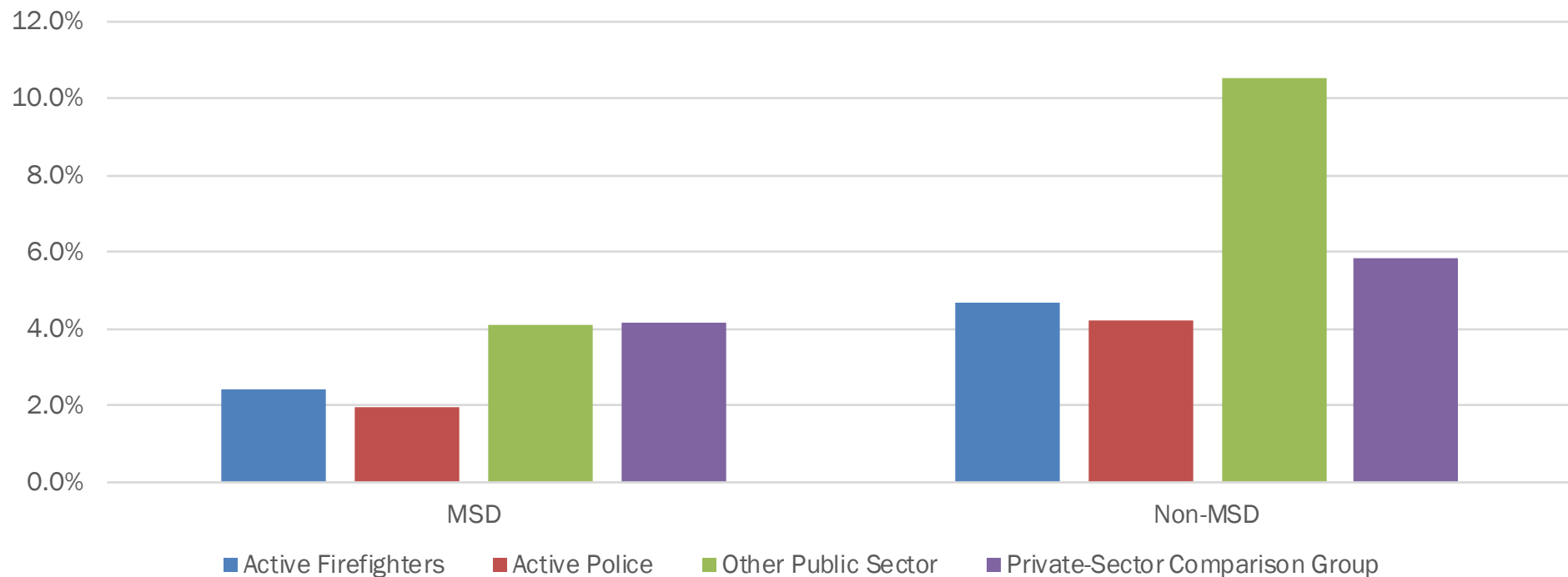


# We Used Medical Claims to Estimate the Incidence of PTSD, Other Psychiatric Distress

- Psychiatric distress following MSD unlikely to be captured in WCIS First, Subsequent Reports of Injury
- Examine medical claims up to 2 years post-injury
- Any diagnosis codes for mental disorders?
  - PTSD, physical signs of PTSD, other mental disorders
- Any prescribed psychiatric medications?
  - Antidepressants or antipsychotics

# Based on Medical Claims, Firefighters, Police Have Lower Psychiatric Condition Incidence

Psychiatric Condition Incidence by Occupation and MSD vs. Non-MSD



# Conclusions

- Work-related musculoskeletal disorders remain more frequent for firefighters than for workers in similar occupations in the public, private sectors
- Economic outcomes worsened during Great Recession and have not fully recovered
- Yet economic consequences for firefighters remain less severe than observed in similar occupations
- **SB 863 increased ratings and statutory benefits**

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# Policy Implications

- Need better prevention efforts to protect firefighters from MSDs
  - Even though economic implications are comparatively low
- Psychiatric claims, impairment ratings much more common on non-MSD claims
- Lower rates of psychiatric conditions consistent with reports of stigma among public-safety workers
- Restriction of add-on psychiatric impairments had limited impact on firefighters with MSD because incidence was already very low



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